Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Hydro-Estimator IPHEx

Introduction

The GPM Ground Validation Hydro-Estimator IPHEx dataset contains rainfall rate estimates derived using NOAA's Geostationary Operational Environmental Satellites (GOES) infrared (IR) brightness temperature data by researchers at the NOAA Center of Satellite Applications and Research's (STAR) using the Hydro-Estimator (H-E) algorithm. Rainfall rate estimates are produced every 15 minutes throughout the continental United States, but for this dataset, have been subset to the North Carolina region for the Integrated Precipitation and Hydrology Experiment (IPHEx) field campaign in support of Global Precipitation Measurement (GPM) ground validation. These data are available in netCDF-4 format and consists of rain rate values from May 1, 2014 through June 16, 2014.

Citation

Scofield, Roderick A., Clay Davenport, and Robert J. Kuligowski. 2018. GPM Ground Validation Hydro-Estimator IPHEx [indicate subset used]. Dataset available online from the NASA EOSDIS Global Hydrology Resource Center Distributed Active Archive Center, Huntsville, Alabama, U.S.A. doi: http://dx.doi.org/10.5067/GPMGV/IPHEX/MULTIPLE/DATA401

Keywords:

NASA, GHRC, IPHEx, GPM, Hydro-Estimator, North Carolina, GOES, infrared, brightness temperature, rainfall rate

Campaign

The Global Precipitation Measurement (GPM) mission Ground Validation campaign used a variety of methods for validation of GPM satellite constellation measurements prior to and after launch of the GPM Core Satellite, which launched on February 27, 2014. The instrument validation effort included numerous GPM-specific and joint agency/international external field campaigns, using state of the art cloud and

precipitation observational infrastructure (polarimetric radars, profilers, rain gauges, and disdrometers). Surface rainfall was measured by very dense rain gauge and disdrometer networks at various field campaign sites. These field campaigns accounted for the majority of the effort and resources expended by GPM GV. More information about the GPM mission is available at https://pmm.nasa.gov/GPM/.

One of the GPM Ground Validation field campaigns was the Integrated Precipitation and Hydrology Experiment (IPHEx) which was held in North Carolina during 2013 and 2014 with an intense study period from May 1 to June 15, 2014. The goal of IPHEx was to characterize warm season orographic precipitation regimes and the relationship between precipitation regimes and hydrologic processes in regions of complex terrain. The IPHEx campaign was part of the development, evaluation, and improvement of remote-sensing precipitation algorithms in support of the GPM mission through NASA GPM Ground Validation field campaign (IPHEX_GVFC) and the evaluation of Quantitative Precipitation Estimation (QPE) products for hydrologic forecasting and water resource applications in the Upper Tennessee, Catawba-Santee, Yadkin-Pee Dee, and Savannah river basins (IPHEX-HAP, H4SE). NOAA Hydrometeorology Testbed (HTM) has synergy with this project. More information about IPHEx is available at http://gpm.nsstc.nasa.gov/iphex/.

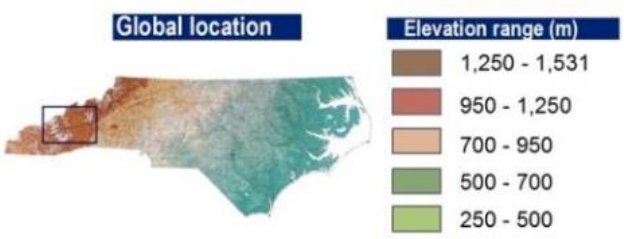

Figure 1: Region of North Carolina IPHEx campaign ground validation (image source: http://gpm-gv.gsfc.nasa.gov/Gauge/)

Product Description

The Hydro-Estimator rain rate product is provided by researchers at the NOAA Center of Satellite Applications and Research (STAR) program. The Hydro-Estimator (H-E) is a single-channel (11 micron) rain rate algorithm that uses the infrared (IR) brightness temperature data from NOAA's Geostationary Operational Environmental Satellite (GOES) imagers and supplementary data to determine rainfall rates. The IR data are calibrated against radar where available and corrections for atmospheric moisture, orography, and convective equilibrium level are made. The algorithm comes from a long heritage of previous products (the Interactive Flash Flood Analyzer from the late 1970's and the Auto-Estimator from the late 1990's). The H-E algorithm improves upon previous algorithms in that it only assigns rain to pixels that are colder than the average brightness temperature of surrounding cloudy pixels. This eliminates the error of assigning high rain rates to cold, non-raining cirrus clouds. It also uses separate precipitable water and relative humidity corrections derived from numerical weather prediction model data to reduce cold-season

overcorrection. More details about the H-E algorithm can be found on the STAR Satellite Rainfall Estimates Hydro-Estimator - Technique Description webpage.

Rainfall rate estimates are produced every 15 minutes throughout the continental United States, but, for this dataset, have been subset to the Iowa region of the IFloodS field campaign. The H-E data product is also available globally through the use of geostationary data other than GOES such as METEOSAT over Europe, Africa, and western Asia, and MTSAT over Eastern Asia. More information about H-E is available on the STAR Satellite Rainfall Estimates - Hydro-Estimator webpage, and from two publications; Vicente et al., 1998, and Scofield, 1987.

Investigators

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Data Characteristics

The GPM Ground Validation Hydro-Estimator IPHEx dataset is a subset of the NOAA/ STAR Hydro-Estimator (H-E). The H-E uses GOES IR brightness temperature data to estimate rainfall rates. This dataset contains rainfall rate estimates in 5-minute intervals. Data in this product are for the IPHEx field campaign study area in netCDF-4 format. These data files are considered Level 4 products. More information about the NASA data processing levels are available on the NASA Data Processing Levels website.

Table 1: Data Characteristics

Characteristic	Description
Platform	Geostationary Operational Environmental Satellites (GOES)
Instrument	GOES Imager
Projection	n/a
Spatial Coverage	N: 42.921, S: 27.897, E: -71.793, W: -91.736 (North Carolina)
Spatial Resolution	~2.5 km
Temporal Coverage	May 1, 2014 - June 16, 2014
Temporal Resolution	15 minutes
Parameter	Rain rate

Version	1
Processing Level	4

File Naming Convention

The GPM Ground Validation Hydro-Estimator IPHEx dataset is available in netCDF-4 format. The data files consist of rainfall rate estimates derived from GOES IR brightness temperature data using the H-E. These data files are in the file naming convention as shown below.

Data files: HE_IPHEX.YYYYJJJhhmm.nc

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
JJJ	Three-digit Julian day
hh	Two-digit hour in UTC
mm	Two-digit minute in UTC
.nc	netCDF-4 file

Data Format and Parameters

This dataset consists of rainfall rate estimates derived from GOES IR brightness temperature data in netCDF-4 format. Table 3 lists and describes the variables available within these data files.

Table 3: Data Fields

Field Name	Description	Data Type	Unit
latitude	Latitude	float	Degrees North
longitude	Longitude	float	Degrees East
rain_rate	Rainfall rate	float	mm/h
time	Time of measurement	int	Seconds since date and time given in the file name

Algorithm

The H-E is a single-channel (11 micrometer) rain rate algorithm that assigns rainfall rate only to pixels that are colder than the average brightness temperature of surrounding cloudy pixels. Users are directed to the details about the STAR Satellite Rainfall Estimates Hydro-Estimator - Technique Description webpage, and in the relevant publications by Vicente et al., 1998, and Scofield, 1987 for more information about the H-E algorithm.

Quality Assessment

The H-E rain rate algorithm assigns rainfall amounts only to pixels colder than the average brightness temperature of surrounding cloudy pixels. This eliminates the error of assigning high rain rates to cold, non-raining cirrus clouds. The algorithm also uses separate precipitable water and relative humidity corrections to reduce cold-season overcorrection. Convective equilibrium adjustments are incorporated into the H-E to enhance rainfall in regions where the convective equilibrium level was too low in height for very cold cloud tops to develop, but where very heavy precipitation is still possible. If the coldest cloud top within a region of interest is no more than 10 degrees K colder than the equilibrium level, then the minimum temperature within this region is used instead of the pixel temperature. More information about the H-E algorithm and adjustments made is available on the STAR Satellite Rainfall Estimates Hydro-Estimator - Technique Description webpage.

Software

These data are available in netCDF-4 format, so no software is required. Panoply can be used to easily view these data.

References

Scofield, Roderick A. (1987): The NESDIS Operational Convective Precipitation Estimation Technique. *Monthly Weather Review*, 115, 1773-1792. doi: https://doi.org/10.1175/1520-0493(1987)115%3C1773:TNOCPE%3E2.0.CO;2

Vicente, Gilberto A., Roderick A. Scofield, and W. Paul Menzel (1998): The Operational GOES Infrared Rainfall Estimation Technique. *Bulletin of the American Meteorological Society*, 79, 9, 1883-1898. doi: https://doi.org/10.1175/1520-0477(1998)079%3C1883:TOGIRE%3E2.0.CO;2

Related Data

All data from other instruments collected during the IFloodS field campaign are related to this dataset. Other IFloodS campaign data can be located using the GHRC HyDRO 2.0 search tool using the term 'IFloodS'.

The Hydro-Estimator data were also gathered in support of the GPM-GV IPHEx field campaign and are available from GHRC:

GPM Ground Validation Hydro-Estimator IFloodS
(http://dx.doi.org/10.5067/GPMGV/IFLOODS/MULTIPLE/DATA101)

Contact Information

To order these data or for further information, please contact:

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